



# Three Decades of Neutrosophic and Plithogenic Theories with their Applications (1995 - 2024)

= plenary lecture =

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Zadeh introduced the **degree of membership/truth** (T) in 1965 and defined the fuzzy set. Atanassov introduced the **degree of nonmembership/falsehood** (F) in 1986 and defined the intuitionistic fuzzy set. Smarandache introduced the **degree of indeterminacy/neutrality** (I) as independent component in 1995 (published in 1998) and he defined the neutrosophic set on three components: (T, I, F) = (Truth, Indeterminacy, Falsehood), where in general T, I, F are subsets of the interval [0, 1]; in particular T, I, F may be intervals, hesitant sets, single-values, etc.; *Indeterminacy* (or *Neutrality*), as independent component from the truth and from the falsehood, is the main distinction between Neutrosophic Theories and other classical and fuzzy theory or fuzzy extension theories:

<https://fs.unm.edu/Indeterminacy.pdf>

See F. Smarandache, Neutrosophy / Neutrosophic probability, set, and logic", Proquest, Michigan, USA, 1998.

<https://arxiv.org/ftp/math/papers/0101/0101228.pdf>

<https://fs.unm.edu/eBook-Neutrosophics6.pdf>;

reviewed in Zentralblatt für Mathematik (Berlin, Germany):

<https://zbmath.org/?q=an:01273000>

And cited by Denis Howe in The Free Online Dictionary of Computing, England, 1999.

Neutrosophic Set and Logic are generalizations of classical, fuzzy, and intuitionist fuzzy set and logic:

<https://arxiv.org/ftp/math/papers/0404/0404520.pdf>

<https://arxiv.org/ftp/math/papers/0303/0303009.pdf>

## Etymology

The words “neutrosophy” and “neutrosophic” were coined/invented by F. Smarandache in his 1998 book. Neutrosophy: A branch of philosophy, introduced by F. Smarandache in 1980, which studies the origin, nature, and scope of neutralities, as well as their interactions with different ideational spectra. Neutrosophy considers a proposition, theory, event, concept, or entity <A> in relation to its opposite <antiA>, and with their neutral <neutA>. Neutrosophy (as dynamic of opposites and their neutrals) is an extension of the Dialectics and Yin Yang (which are the dynamic of opposites only).

Neutrosophy is the basis of neutrosophic set, neutrosophic logic, neutrosophic measure, neutrosophic probability, neutrosophic statistics etc.

<https://arxiv.org/ftp/math/papers/0010/0010099.pdf>

Neutrosophic Set is a Generalization of Intuitionist Fuzzy Set, Inconsistent Intuitionist Fuzzy Set (Picture Fuzzy Set, Ternary Fuzzy Set), Pythagorean Fuzzy Set (Atanassov's Intuitionist Fuzzy Set of second type), q-Rung Orthopair Fuzzy Set, Spherical Fuzzy Set, and n-HyperSpherical Fuzzy Set, while Neutrosophication is a Generalization of Regret Theory, Grey System Theory, and Three-Ways Decision.

<https://arxiv.org/ftp/arxiv/papers/1911/1911.07333.pdf>  
<https://fs.unm.edu/Raspunsatan.pdf>

Neutrosophic Logic is a general framework for unification of many existing logics, such as fuzzy logic (especially intuitionistic fuzzy logic), paraconsistent logic, intuitionist logic, etc. The main idea of NL is to characterize each logical statement in a 3D-Neutrosophic Space, where each dimension of the space represents respectively the truth (T), the falsehood (F), and the indeterminacy (I) of the statement under consideration, where T, I, F are standard or non-standard real subsets of  $]0, 1[$  with not necessarily any connection between them. For all engineering, technical, administrative and other practical applications the classical unit interval  $[0, 1]$  should be used. While Neutrosophic Probability and Statistics are generalizations of classical and imprecise probability and classical statistics respectively.

### The Most Important Books and Papers on the Advancement of Neutrosophics

1980s - Foundation of **Paradoxism** that is an international movement in science and culture based on excessive use of contradictions, antitheses, oxymoron, and paradoxes [Smarandache]. During three decades (1980-2020) hundreds of authors from tens of countries around the globe contributed papers to 15 international paradoxist anthologies: <https://fs.unm.edu/a/paradoxism.htm>

1995-1998 – Smarandache extended the paradoxism (*based on opposites*) to a new branch of philosophy called **Neutrosophy** (*based on opposites and their neutral/indeterminacies*), that gave birth to many scientific branches, such as: neutrosophic logic, neutrosophic set, neutrosophic probability and statistics, neutrosophic algebraic structures, and so on with multiple applications in all fields.

**Neutrosophy** is also an extension of the *Dialectics*, the *Yin-Yang* ancient Chinese philosophy, the *Manichaeism*, and in general of the *Dualism*.

<https://fs.unm.edu/Neutrosophy-A-New-Branch-of-Philosophy.pdf>

Introduced the neutrosophic set/logic/probability/statistics; introduces the single-valued neutrosophic set (pp. 7-8);

<https://arxiv.org/ftp/math/papers/0101/0101228.pdf> (fourth edition)  
<https://fs.unm.edu/eBook-Neutrosophics6.pdf> (online sixth edition)

Single Valued Neutrosophic Sets

<https://fs.unm.edu/SingleValuedNeutrosophicSets.pdf>

**Indeterminacy** in Neutrosophic Theories and their Applications.

<https://fs.unm.edu/Indeterminacy.pdf>

1998, 2019 - Extended **Nonstandard Neutrosophic Logic, Set, Probability based on NonStandard Analysis**

<https://arxiv.org/ftp/arxiv/papers/1903/1903.04558.pdf> <https://fs.unm.edu/AdvancesOfStandardAndNonstandard.pdf>

**Improved Definition of NonStandard Neutrosophic Logic** and Introduction to **Neutrosophic Hyperreals** (Third version), arXiv, Cornell University, New York City, USA, <https://arxiv.org/ftp/arxiv/papers/1812/1812.02534.pdf>,  
<https://fs.unm.edu/NonStandardAnalysis-Imamura-proven-wrong.pdf>

2002 – Introduction of **corner cases of sets / probabilities / statistics / logics**, such as:  
- Neutrosophic intuitionistic set (different from intuitionist fuzzy set), neutrosophic paraconsistent set, neutrosophic faillibilist set, neutrosophic paradoxist set, neutrosophic pseudo-paradoxist set, neutrosophic tautological set, neutrosophic nihilist set, neutrosophic dialetheist set, neutrosophic trivialist set;  
- Neutrosophic intuitionistic probability and statistics, neutrosophic paraconsistent probability and statistics, neutrosophic faillibilist probability and statistics, neutrosophic paradoxist probability and statistics, neutrosophic pseudo-paradoxist probability and statistics, neutrosophic tautological probability and statistics, neutrosophic nihilist probability and statistics, neutrosophic dialetheist probability and statistics, neutrosophic trivialist probability and statistics;

- Neutrosophic paradoxist logic (or paradoxism), neutrosophic pseudo-paradoxist logic (or neutrosophic pseudo-paradoxism), neutrosophic tautological logic (or neutrosophic tautologism):  
<https://arxiv.org/ftp/math/papers/0301/0301340.pdf>  
<https://fs.unm.edu/DefinitionsDerivedFromNeutrosophics.pdf>

2003 – Introduction by Kandasamy and Smarandache of **Neutrosophic Numbers** ( $a+bI$ , where  $I = \text{literal indeterminacy}$ ,  $I^2 = I$ , which is different from the *numerical indeterminacy*  $I = \text{real set}$ ), **I-Neutrosophic Algebraic Structures** and **Neutrosophic Cognitive Maps**

<https://arxiv.org/ftp/math/papers/0311/0311063.pdf>  
<https://fs.unm.edu/NCMs.pdf>

2005 - Introduction of **Interval Neutrosophic Set/Logic**

<https://arxiv.org/pdf/cs/0505014.pdf>  
<https://fs.unm.edu/INSL.pdf>

2006 – Introduction of **Degree of Dependence and Degree of Independence between the Neutrosophic Components T, I, F**.  
For single valued neutrosophic logic, the sum of the components is:  
 $0 \leq t+i+f \leq 3$  when all three components are independent;  
 $0 \leq t+i+f \leq 2$  when two components are dependent, while the third one is independent from them;  
 $0 \leq t+i+f \leq 1$  when all three components are dependent.  
When three or two of the components T, I, F are independent, one leaves room for background incomplete information (sum < 1), paraconsistent and contradictory information (sum > 1), or complete information (sum = 1).  
If all three components T, I, F are dependent, then similarly one leaves room for incomplete information (sum < 1), or complete information (sum = 1).  
In general, the sum of two components x and y that vary in the unitary interval [0, 1] is:  
 $0 \leq x + y \leq 2 - d^\circ(x, y)$ , where  $d^\circ(x, y)$  is the degree of dependence between x and y, while  $d^\circ(x, y)$  is the degree of independence between x and y.  
Degrees of Dependence and Independence between Neutrosophic Components T, I, F are independent components, leaving room for *incomplete information* (when their superior sum < 1), *paraconsistent and contradictory information* (when the superior sum > 1), or *complete information* (sum of components = 1).  
For software engineering proposals the classical unit interval [0, 1] is used.

<https://doi.org/10.5281/zenodo.571359>  
<https://fs.unm.edu/eBook-Neutrosophics6.pdf> (p. 92)  
<https://fs.unm.edu/NSS/DegreeOfDependenceAndIndependence.pdf>

2007 – The Neutrosophic Set was extended [Smarandache, 2007] to **Neutrosophic Overset** (when some neutrosophic component is  $> 1$ ), since he observed that, for example, an employee working overtime deserves a degree of membership  $> 1$ , with respect to an employee that only works regular full-time and whose degree of membership = 1; and to **Neutrosophic Underset** (when some neutrosophic component is  $< 0$ ), since, for example, an employee making more damage than benefit to his company deserves a degree of membership  $< 0$ , with respect to an employee that produces benefit to the company and has the degree of membership  $> 0$ ; and to **Neutrosophic Offset** (when some neutrosophic components are off the interval  $[0, 1]$ , i.e. some neutrosophic component  $> 1$  and some neutrosophic component  $< 0$ ). Then, similarly, the Neutrosophic Logic/Measure/Probability/Statistics etc. were extended to respectively **Neutrosophic Over-/Under-/Off- Logic / Measure / Probability / Statistics** etc.  
<https://arxiv.org/ftp/arxiv/papers/1607/1607.00234.pdf>  
<https://fs.unm.edu/NeutrosophicOversetUndersetOffset.pdf>  
<https://fs.unm.edu/SVNeutrosophicOverset-JML.pdf>  
<https://fs.unm.edu/TV-Neutrosophic-Overset-Underset-Offset.pdf>  
<https://fs.unm.edu/NSS/DegreesOf-Over-Under-Off-Membership.pdf>

2007 – Smarandache introduced the **Neutrosophic Tripolar Set** and **Neutrosophic Multipolar Set** and consequently the **Neutrosophic Tripolar Graph** and **Neutrosophic Multipolar Graph**  
<https://fs.unm.edu/eBook-Neutrosophics6.pdf> (p. 93)  
<https://fs.unm.edu/IFS-generalized.pdf>

2009 – Introduction of **N-norm** and **N-conorm**  
<https://arxiv.org/ftp/arxiv/papers/0901/0901.1289.pdf>  
<https://fs.unm.edu/N-normN-conorm.pdf>

2013 – Development of **Neutrosophic Measure** and **Neutrosophic Probability** (*chance that an event occurs, indeterminate chance of occurrence, chance that the event does not occur*)  
<https://arxiv.org/ftp/arxiv/papers/1311/1311.7139.pdf>  
<https://fs.unm.edu/NeutrosophicMeasureIntegralProbability.pdf>

2013 – Smarandache **Refined / Split the Neutrosophic Components** (T, I, F) into Neutrosophic SubComponents ( $T_1, T_2, \dots; I_1, I_2, \dots; F_1, F_2, \dots$ ):  
<https://arxiv.org/ftp/arxiv/papers/1407/1407.1041.pdf>  
<https://fs.unm.edu/n-ValuedNeutrosophicLogic-PiP.pdf>

2014 – Introduction of the **Law of Included Multiple-Middle** (as extension of the Law of Included Middle) ( $\langle A \rangle; \langle \text{neut}A_1 \rangle, \langle \text{neut}A_2 \rangle, \dots, \langle \text{neut}A_n \rangle; \langle \text{anti}A \rangle$ )  
<https://fs.unm.edu/LawIncludedMultiple-Middle.pdf>

and the **Law of Included Infinitely-Many-Middles** (2023)

<https://fs.unm.edu/NSS/LawIncludedInfinitely1.pdf>  
 $\langle A \rangle; \langle \text{neut}A_1 \rangle, \langle \text{neut}A_2 \rangle, \dots, \langle \text{neut}A_{\text{infinity}} \rangle; \langle \text{anti}A \rangle$

2014 - Development of **Neutrosophic Statistics** (*indeterminacy* is introduced into classical statistics with respect to any data regarding the sample / population, probability distributions / laws / graphs / charts etc., with respect to the individuals that only partially belong to a sample / population, and so on):

<https://fs.unm.edu/NS/NeutrosophicStatistics.htm>

**Neutrosophic Numbers** used in Neutrosophic Statistics

<https://fs.unm.edu/NS/AppurtenanceInclusionEquations-revised.pdf>

2015 - Extension of the Analytical Hierarchy Process (AHP) to  **$\alpha$ -Discounting Method for Multi-Criteria**

**Decision Making ( $\alpha$ -D MCDC)**

<https://fs.unm.edu/ScArt/AlphaDiscountingMethod.pdf>

<https://fs.unm.edu/ScArt/CP-IntervalAlphaDiscounting.pdf>

<https://fs.unm.edu/ScArt/ThreeNonLinearAlpha.pdf>

<https://fs.unm.edu/alpha-DiscountingMCDM-book.pdf>

2015 - Introduction of **Neutrosophic Precalculus** and **Neutrosophic Calculus**

<https://arxiv.org/ftp/arxiv/papers/1509/1509.07723.pdf>

<https://fs.unm.edu/NeutrosophicPrecalculusCalculus.pdf>

2015 – **Refined Neutrosophic Numbers**  $(a + b_1I_1 + b_2I_2 + \dots + b_nI_n)$ , where  $I_1, I_2, \dots, I_n$  are SubIndeterminacies of Indeterminacy I.

2015 – **(t,i,f)-Neutrosophic Graphs**.

2015 - **Thesis-AntiThesis-NeutroThesis**, and NeutroSynthesis, Neutrosophic Axiomatic System, neutrosophic dynamic systems, symbolic neutrosophic logic, (t, i, f)-Neutrosophic Structures, I-Neutrosophic Structures, Refined Literal Indeterminacy, Quadruple Neutrosophic Algebraic Structures, Multiplication Law of SubIndeterminacies, and Neutrosophic Quadruple Numbers of the form  $a + bT + cI + dF$ , where T, I, F are literal neutrosophic components, and a, b, c, d are real or complex numbers:

<https://arxiv.org/ftp/arxiv/papers/1512/1512.00047.pdf>

<https://fs.unm.edu/SymbolicNeutrosophicTheory.pdf>

$$I_0^k = \frac{k}{0}$$

2015 – Introduction of the **SubIndeterminacies** of the form  $I_0^k$ , for  $k \in \{0, 1, 2, \dots, n-1\}$ , into the ring of modulo integers  $Z_n$  - called natural neutrosophic indeterminacies (Vasanth-Smarandache)

<https://fs.unm.edu/MODNeutrosophicNumbers.pdf>

2015 – Introduction of **Neutrosophic Crisp Set and Topology** (Salama & Smarandache)

<https://fs.unm.edu/NeutrosophicCrispSetTheory.pdf>

2016 - **Addition, Multiplication, Scalar Multiplication, Power, Subtraction, and Division of Neutrosophic Triplets (T, I, F)**

<https://fs.unm.edu/CR/SubstractionAndDivision.pdf>

2016 – Introduction of **Neutrosophic Multisets** (as generalization of classical multisets)

<https://fs.unm.edu/NeutrosophicMultisets.htm>

2016 – Introduction of **Neutrosophic Triplet Structures** and m-valued refined neutrosophic triplet structures [Smarandache - Ali]  
<https://fs.unm.edu/NeutrosophicTriplets.htm>

2016 – Introduction of **Neutrosophic Duplet Structures**

<https://fs.unm.edu/NeutrosophicDuplets.htm>

2017 - 2020 - **Neutrosophic Score, Accuracy, and Certainty Functions** form a total order relationship on the set of (single-valued, interval-valued, and in general subset-valued) neutrosophic triplets (T, I, F); and these functions are used in MCDM (Multi-Criteria Decision Making): <https://fs.unm.edu/NSS/TheScoreAccuracyAndCertaintv1.pdf>

2017 - In biology Smarandache introduced the **Theory of Neutrosophic Evolution: Degrees of Evolution, Indeterminacy or Neutrality, and Involution** (as extension of *Darwin's Theory of Evolution*):  
<https://fs.unm.edu/neutrosophic-evolution-PP-49-13.pdf>

<https://fs.unm.edu/V/NeutrosophicEvolution.mp4>

<https://fs.unm.edu/NeutrosophicEvolution.pdf>

2017 - Introduction by F. Smarandache of **Plithogeny** (as generalization of Yin-Yang, Manichaeism, Dialectics, Dualism, and Neutrosophy), and **Plithogenic Set / Plithogenic Logic as generalization of MultiVariate Logic / Plithogenic Probability and Plithogenic Statistics as generalizations of MultiVariate Probability and Statistics** (as generalization of fuzzy, intuitionistic fuzzy, neutrosophic set/logic/probability/statistics):  
<https://arxiv.org/ftp/arxiv/papers/1808/1808.03948.pdf>  
<https://fs.unm.edu/Plithogenv.pdf>

2017 - Enunciation of the Law that: **It Is Easier to Break from Inside than from Outside a Neutrosophic Dynamic System** (Smarandache - Vatuui):

<https://fs.unm.edu/EasierMaiUsor.pdf>

2018 - 2023 - Introduction of new types of soft sets: **HyperSoft Set, IndetermSoft Set, IndetermHyperSoft Set, SuperHyperSoft Set, TreeSoft Set**:

<https://fs.unm.edu/TSS/NewTypesSoftSets-Improved.pdf>

<https://fs.unm.edu/TSS/SuperHyperSoftSet.pdf>

<https://fs.unm.edu/NSS/IndetermSoftIndetermHyperSoft38.pdf>

(with *IndetermSoft Operators* acting on *IndetermSoft Algebra*)

<https://fs.unm.edu/TSS/>

2018 – Introduction to **Neutrosophic Psychology** (*Neutropsyche, Refined Neutrosophic Memory: conscious, aconscious, unconscious, Neutropsychic Personality, Eros / Aoristos / Thanatos, Neutropsychic Crisp Personality*):

<https://fs.unm.edu/NeutropsychicPersonality-ed3.pdf>

2019 - Theory of Spiral Neutrosophic Human Evolution (Smarandache - Vatuui):  
<https://fs.unm.edu/SpiralNeutrosophicEvolution.pdf>

2019 - Introduction to **Neutrosophic Sociology** (*NeuroSociology*) [neutrosophic concept, or (T, I, F)-concept, is a concept that is T% true, I% indeterminate, and F% false]:  
<https://fs.unm.edu/Neutrosociology.pdf>

2019 - **Refined Neutrosophic Crisp Set**

<https://fs.unm.edu/RefinedNeutrosophicCrispSet.pdf>

2019-2024 - Introduction of sixteen new types of topologies: **NonStandard Topology, Largest Extended NonStandard Real Topology, Neutrosophic Triplet Weak/Strong Topologies, Neutrosophic Extended Triplet Weak/Strong Topologies, Neutrosophic Duplet Topology, Neutrosophic Extended Duplet Topology, Neutrosophic MultiSet Topology, NonStandard Neutrosophic Topology, NeutroTopology, AntiTopology, Refined Neutrosophic Topology, Refined Neutrosophic Crisp Topology, SuperHyperTopology, and Neutrosophic SuperHyperTopology:**

<https://fs.unm.edu/TT/RevolutionaryTopologies.pdf>

<https://fs.unm.edu/TT/>

2019 - Generalization of the classical Algebraic Structures to NeutroAlgebraic Structures (or **NeutroAlgebras**) {whose operations and axioms are partially true, partially indeterminate, and partially false} as extensions of **Partial Algebra**, and to AntiAlgebraic Structures (or AntiAlgebras) {whose operations and axioms are totally false}.

<https://fs.unm.edu/NA/NeutroAlgebra.htm>

<https://fs.unm.edu/NA/NeutroAlgebra.pdf>

And, in general, he extended any classical Structure, in no matter what field of knowledge, to a **NeutroStructure** and an **AntiStructure**:

<https://fs.unm.edu/NA/NeutroStructure.pdf>

As alternatives and generalizations of the **Non-Euclidean Geometries** he introduced in 2021 the **NeutroGeometry & AntiGeometry**. While the Non-Euclidean Geometries resulted from the total negation of only one specific axiom (Euclid's Fifth Postulate), the **AntiGeometry results from the total negation of any axiom and even of more axioms from any geometric axiomatic system (Euclid's, Hilbert's, etc.), and the NeutroGeometry results from the partial negation of one or more axioms [and no total negation of no axiom] from any geometric axiomatic system.**

<https://fs.unm.edu/NSS/NeutroGeometryAntiGeometry31.pdf>

<https://fs.unm.edu/NG/>

2019-2022 - Extension of HyperGraph to SuperHyperGraph and Neutrosophic SuperHyperGraph

<https://fs.unm.edu/NSS/n-SuperHyperGraph.pdf>

2020 - Introduction to Neutrosophic Genetics: <https://fs.unm.edu/NeutrosophicGenetics.pdf>

2021 - Introduction to Neutrosophic Number Theory (Abobala)

<https://fs.unm.edu/NSS/FoundationsOfNeutrosophicNumberTheory10.pdf>

2021 - As alternatives and generalizations of the Non-Euclidean Geometries, Smarandache introduced in 2021 the NeutroGeometry & AntiGeometry. While the Non-Euclidean Geometries resulted from the total negation of only one specific axiom (Euclid's Fifth Postulate), the AntiGeometry results from the total negation of any axiom and even of more axioms from any geometric axiomatic system (Euclid's, Hilbert's, etc.), and the NeutroGeometry results from the partial negation of one or more axioms [and no total negation of no axiom] from any geometric axiomatic system:

<https://fs.unm.edu/NSS/NeutroGeometryAntiGeometry31.pdf>

Real Examples of NeutroGeometry and AntiGeometry:

<https://fs.unm.edu/NSS/ExamplesNeutroGeometryAntiGeometry35.pdf>

2021 - Introduction of Plithogenic Logic as a generalization of MultiVariate Logic

<https://fs.unm.edu/NSS/IntroductionPlithogenicLogic1.pdf>

2021 - Introduction of Plithogenic Probability and Statistics as generalizations of MultiVariate Probability and Statistics respectively

<https://fs.unm.edu/NSS/PlithogenicProbabilityStatistics20.pdf>

2021 - Introduction of the AH-Isometry  $f(x+yI) = f(x) + I[f(x+y) - f(x)]$  and foundation of the Neutrosophic Euclidean Geometry (by Abobala & Hatip).

<https://fs.unm.edu/NSS/AlgebraicNeutrosophicEuclideanGeometry10.pdf>

and extension to n-Refined AH-Isometry (Smarandache & Abobala, 2024)

<https://fs.unm.edu/NSS/RefinedLiteral21.pdf>

2016 - 2022 SuperHyperAlgebra & Neutrosophic SuperHyperAlgebra

<https://fs.unm.edu/SuperHyperAlgebra.pdf>

2022 - SuperHyperFunction, SuperHyperTopology

<https://fs.unm.edu/NSS/SuperHyperFunction37.pdf>

2022 - 2023 Neutrosophic Operational Research (Smarandache - Jdid)

<https://fs.unm.edu/NeutrosophicOperationsResearch.pdf>

**2023 - Symbolic Plithogenic Algebraic Structures** built on the set of Symbolic Plithogenic Numbers of the form  $a_0 + a_1P_1 + a_2P_2 + \dots + a_nP_n$  where the multiplication  $P_i \cdot P_j$  is based on the prevalence order and absorbance law <https://fs.unm.edu/NSS/SymbolicPlithogenicAlgebraic39.pdf>

**2023 - Foundation of Neutrosophic Cryptology** (Merkepçi-Abobala-Allouf)

<https://fs.unm.edu/NeutrosophicCryptography1.pdf>

<https://fs.unm.edu/NeutrosophicCryptography2.pdf>

<https://fs.unm.edu/NSS/2OnANovelSecurityScheme.pdf>

**2023 - The MultiNeutrosophic Set** (a neutrosophic set whose elements' degrees T, I, F are evaluated by multiple sources):

<https://fs.unm.edu/NSS/MultiNeutrosophicSet.pdf>

**2023 - The MultiAlist System of Thought** (an open dynamic system of many opposites, with their neutralities or indeterminacies, formed by elements from many systems):

<https://fs.unm.edu/NSS/MultiAlistSystemOfThought.pdf>

**2023 - Appurtenance Equation, Inclusion Equation, & Neutrosophic Numbers used in Neutrosophic Statistics.**

<https://fs.unm.edu/NS/AppurtenanceInclusionEquations-revised.pdf>

**2024 - SuperHyperStructure and Neutrosophic SuperHyperStructure**

<https://fs.unm.edu/SHS/>

**2024 - Zarathustra & Neutrosophy**

<https://fs.unm.edu/Zoroastrianism.pdf>

**The Principles of (Partial Locality, Partial Indeterminacy, Partial NonLocality) and (Multi Locality, Multi Indeterminacy, Multi NonLocality)**

<https://fs.unm.edu/nss8/index.php/111/article/view/4858/2043>

**Neutrosophy Transcends Binary Oppositions in Mythology and Folklore**

<https://fs.unm.edu/NSS/NeutrosophyTranscendsBinary4.pdf>

**Neutrosophy means: Common Parts to Uncommon Things and Uncommon Parts to Common Things**

<https://fs.unm.edu/NSS/NeutroMeans1.pdf>

**2024 - Upside-Down Logics: Falsification of the Truth & Truthification of the False**

<https://fs.unm.edu/Upside-DownLogics.pdf>

**2024 - Neutrosophic (and fuzzy-extensions) TwoFold Algebra**

<https://fs.unm.edu/NeutrosophicTwoFoldAlgebra.pdf>

#### Applications in:

Artificial Intelligence, Information Systems, Computer Science, Cybernetics, Theory Methods, Mathematical Algebraic Structures, Applied Mathematics, Automation, Control Systems, Big Data, Engineering, Electrical, Electronic, Philosophy, Social Science, Psychology, Biology, Biomedical, Genetics, Engineering, Medical Informatics, Operational Research, Management Science, Imaging Science, Photographic Technology, Instruments, Instrumentation, Physics, Optics, Economics, Mechanics, Neurosciences, Radiology Nuclear, Medicine, Medical Imaging, Interdisciplinary Applications, Multidisciplinary Sciences etc. [ Xindong Peng and Jingguo Dai, A bibliometric analysis of neutrosophic set: two decades review from 1998 to 2017, Artificial Intelligence Review, Springer, 18 August 2018; <https://fs.unm.edu/BibliometricNeutrosophy.pdf> ]

#### Neutrosophic Researchers:

There are about 7,500 neutrosophic researchers, within 90 countries around the globe, that have produced about 4,000 articles and books, and over 70 PhD and MSc theses, within more than three decades. Many neutrosophic researchers got specialized into various fields of neutrosophics, plithogenics, NeutroAlgebra and AntiAlgebra, NeutroGeometry and AntiGeometry, new types of topologies, new types of soft sets, SuperHyperStructures, etc.

#### References

University of New Mexico (USA) web sites:

<https://fs.unm.edu/neutrosophy.htm>  
<https://fs.unm.edu/NSS/Articles.htm>  
<https://fs.unm.edu/CR/CR-Articles.htm>  
<https://fs.unm.edu/NCML/Articles.htm> (Spanish)  
<https://fs.unm.edu/NK/Articles.htm> (Arabic, Turkish, French)

#### Other journals:

**Neutrosophic Optimization and Intelligent Systems (NOIS)**

<https://sciencesforce.com/index.php/nois>

**Plithogenic Logic and Computation (PLC)**

<https://sciencesforce.com/index.php/plc>

**HyperSoft Set Methods in Engineering (HSSE)**

<https://sciencesforce.com/index.php/hsse>

**Information Sciences with Applications (ISWA)**

<https://sciencesforce.com/index.php/iswa>

**Neutrosophic Systems And Application (NSWA)**

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